

SOME MINERALS FOUND IN PENNSYLVANIA**NATIVE ELEMENTS**

GOLD: Au. Gold color. Metallic luster. High specific gravity. Very rare as tiny flakes, many barely visible, which can be found by panning in streams.

* **COPPER:** Cu. Reddish-brown. Metallic luster. Irregular masses. Found at South Mountain in Adams, Cumberland, and Franklin Counties, where it was locally prospected.

* **SULFUR:** S. Yellow or reddish-yellow. Resinous luster. Irregular masses. Rarely found in some limestones. Fine, delicate crystals also form by sublimation from gases emitted by coal-mine fires.

* **GRAPHITE:** C. Black. Metallic to dull luster. Scaly, radiating, or earthy masses; rare tabular crystals. Very soft, will mark paper. Found in marble in southeastern Pennsylvania.

SULFIDES

* **GALENA:** PbS. Gray. Metallic luster. Very dense. Cubic crystals and masses. Scattered deposits in southeastern and central Pennsylvania. Formerly mined in those areas.

* **SPHALERITE:** ZnS. Yellowish-brown and other colors. Usually resinous luster. Mostly irregular masses. Dense. Often found in deposits with galena. Was formerly mined in eastern and central Pennsylvania.

* **CHALCOPYRITE:** CuFeS₂. Brass-yellow. Metallic luster. Mostly found as irregular masses in large iron deposits in southeastern Pennsylvania. Also found in small quantities in other areas of the state.

WURTZITE: ZnS. Brownish-black. Resinous luster. Found as small crystals in limestone in western Pennsylvania. Some of the wurtzite is found in barite-filled cracks in siderite concretions, which are rounded areas of minerals that are distinct from the minerals in the surrounding rock.

* **PYRITE:** FeS₂. Pale-yellow. Metallic luster. "Fool's gold." Crystals and irregular masses are found in small quantities in many sedimentary rocks statewide. Some larger quantities are associated with iron deposits in southeastern Pennsylvania.

OXIDES AND HYDROXIDES

* **MAGNETITE:** Fe_3O_4 . Black. Metallic luster. Attracted to magnets. Crystals and irregular masses. Large deposits in Lebanon and Berks Counties served as the principal ore mineral of iron mines. Also found in small quantities in rocks and surficial deposits statewide. Can be collected from sand in many streams by using a magnet.

CHROMITE: $(\text{Mg,Fe})\text{Cr}_2\text{O}_4$. Black. Metallic luster. Irregular masses and small crystals. Was mined for chromium in southeastern Pennsylvania. Southern Lancaster County was the world's leading source of chromium in the 1800s. Chromite is found in sand in streams in areas of serpentine bedrock.

* **HEMATITE:** Fe_2O_3 . Irregular masses are typically red and earthy; crystals can be gray and have metallic luster. Was used as an iron ore in colonial times in eastern Pennsylvania. Found in small quantities in sedimentary rocks statewide. Thought to be what makes Triassic and some other sedimentary rocks red.

GOETHITE: $\text{FeO}(\text{OH})$. Commonly yellowish-brown and earthy irregular masses. Principal mineral in "limonite," which is a mixture of iron oxides. Limonite formed from the oxidation of pyrite has the same form as the pyrite crystals. Was mined for iron in small operations from colonial times to the late 1800s in eastern and central Pennsylvania.

HALIDES

* **HALITE:** NaCl . Normally white. Vitreous luster. Soluble in water. Salty taste. Large, deep, subsurface deposits of halite are found in northern and western Pennsylvania. Rocks consisting primarily of halite are called evaporites. Some sedimentary rocks in Pennsylvania contain casts of halite crystals that dissolved long ago.

* **FLUORITE:** CaF_2 . Purple is the common color in Pennsylvania. Also colorless, white, green, blue, or yellow. Vitreous luster. Small crystals and cleavage fragments are found in several locations in south-central and eastern Pennsylvania.

CARBONATES

* **CALCITE:** CaCO_3 . Colorless and transparent, white to gray and opaque, other colors; may be yellowish. Vitreous luster. Found as crystals in some places. The principal mineral forming large limestone deposits in many areas of the state. Also forms marble in the regions of metamorphic rock in southeastern Pennsylvania.

* **DOLOMITE:** $\text{CaMg}(\text{CO}_3)_2$. Colorless and transparent, white to gray and opaque, other colors; may be yellowish. Vitreous luster. Found as crystals and masses. Forms large deposits of dolomite rock in many areas, especially in south-central and southeastern Pennsylvania.

SIDERITE: FeCO_3 . Yellowish-brown to reddish-brown. Vitreous luster. Widespread occurrence as nodules in the coal-producing regions of western Pennsylvania. Some crystals. Also found in several places in eastern Pennsylvania.

SULFATES

CELESTINE: SrSO_4 . Pale blue or colorless. Vitreous luster. Fibrous masses and small crystals. The world's first discovery of celestine was in Blair County in 1791. Proposed to be the state mineral of Pennsylvania, awaiting approval as of May 2004.

* **GYPSUM:** $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. Colorless or white. Vitreous or pearly luster. Small crystals found in small scattered deposits associated with shales and carbonate rocks. Probably exists in larger subsurface deposits associated with evaporites.

MELANTERITE: $\text{Fe}^{2+}\text{SO}_4 \cdot 7\text{H}_2\text{O}$. White. Vitreous luster. Metallic taste. This and some other sulfates are commonly seen as powdery coatings or small crystals on shale. Forms from the oxidation of pyrite in the shale.

BARITE: BaSO_4 . White to gray, blue, red, or brown. Vitreous luster. High specific gravity. Found as irregular masses and crystals. Most common in southeastern and south-central Pennsylvania.

PHOSPHATES

* **APATITE GROUP:** Carbonate-fluorapatite ($\text{Ca}_5(\text{PO}_4, \text{CO}_3)_3\text{F}$), fluorapatite, ($\text{Ca}_5(\text{PO}_4)_3\text{F}$), and carbonate-hydroxylapatite ($\text{Ca}_5(\text{PO}_4, \text{CO}_3)_3\text{OH}$) are probably the most common members of this group in Pennsylvania. Various shades of green, white, brown, and red. Subresinous to vitreous luster. Apatite minerals are found in a number of places. Fluorapatite is found as tiny crystals in igneous and metamorphic rocks of southeastern Pennsylvania. Carbonate-fluorapatite has been reported in fossilized bone from sedimentary rocks in central Pennsylvania.

WAVELLITE: $\text{Al}_3(\text{PO}_4)_2(\text{OH}, \text{F})_3 \cdot 5\text{H}_2\text{O}$. Colorless, white, or green. Vitreous or pearly luster. Radiating clusters of crystals are found in south-central and southeastern Pennsylvania.

SILICATES

* **QUARTZ:** SiO_2 . Commonly colorless and transparent; many other colors possible. Vitreous luster. Varieties include amethyst, chalcedony (flint or chert), jasper, smoky quartz, and rose quartz. Very abundant in most sedimentary, metamorphic, and igneous rocks statewide. Crystals are found in numerous locations.

* **FELDSPAR GROUP:** Plagioclase (a continuous series of compositions ranging from albite, $\text{NaAlSi}_3\text{O}_8$, to anorthite, $\text{CaAl}_2\text{Si}_2\text{O}_8$), and orthoclase and microcline (both $\text{KAl}(\text{Si}_3\text{O}_8)$) are the most common feldspars in Pennsylvania. Various shades of white, gray, pink, and other colors. Vitreous luster. Abundant in many sedimentary, metamorphic, and igneous rocks statewide.

KAOLINITE-SERPENTINE GROUP: Kaolinite ($\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$), antigorite ($(\text{Mg}, \text{Fe}^{2+})_3\text{Si}_2\text{O}_5(\text{OH})_4$), and clinochrysotile and lizardite (both $\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_4$) are the most common members of this group in Pennsylvania. Kaolinite exists as tiny particles in clay. It is normally whitish and has an earthy texture. It is found in shale and other fine-grained rocks in many places in Pennsylvania. The other three minerals are commonly green and have a waxy or silky luster. Clinochrysotile is commonly fibrous; antigorite and lizardite are massive. Serpentine minerals make up the bulk of the altered ultramafic rocks known as serpentinite, which are found in Delaware, Chester, and Lancaster Counties. Serpentine is also found in metamorphic rocks in Northampton County.

* **MICA GROUP:** In Pennsylvania, the most common members of this large group are muscovite ($\text{KAl}_2(\text{AlSi}_3)\text{O}_{10}(\text{OH})_2$) and biotite ($(\text{K}, \text{Mg}, \text{Fe}^{2+})_3\text{AlSi}_3\text{O}_{10}(\text{OH})_2$). Muscovite is colorless or pale shades of green or brown; biotite is darker. Both have a vitreous or pearly luster and are easily separated into very thin sheets that spring back when bent. Mica is abundant in many sedimentary, metamorphic, and igneous rocks statewide. Large sheets of muscovite are found in some rocks in southeastern Pennsylvania. The weathered form of mica, illite, is a clay mineral and a major component of shale.

CHLORITE GROUP: Clinocllore ($(\text{Mg}, \text{Fe}^{2+})_5\text{Al}(\text{Si}_3\text{Al})\text{O}_{10}(\text{OH})_8$) and chamosite ($(\text{Fe}^{2+}, \text{Mg}, \text{Fe}^{3+})_5\text{Al}(\text{Si}_3\text{Al})\text{O}_{10}(\text{OH}, \text{O})_8$) are the most commonly found chlorites in Pennsylvania. Both tend to be green or brown. Vitreous to earthy luster. Large specimens can be easily separated into very thin sheets that are easily bent. Chlorite is abundant in metamorphic rocks, some of which contain large sheets. It is also abundant as a clay mineral in shale.

AMPHIBOLE GROUP: There are 65 minerals belonging to the amphibole group. Many amphiboles are found in Pennsylvania. Among them are two hornblende minerals, ferrohornblende and magnesiohornblende ($\text{Ca}_2[(\text{Fe}^{2+}, \text{Mg})_4(\text{Al}, \text{Fe}^{3+})]\text{Si}_7\text{AlO}_{22}(\text{OH})_2$), and actinolite ($\text{Ca}_2(\text{Mg}, \text{Fe}^{2+})_5\text{Si}_8\text{O}_{22}(\text{OH})_2$). The hornblendes are usually dark green to black and have a vitreous luster. They form short columnar crystals in the metamorphic rocks of southeastern Pennsylvania. Actinolite is white or green, has a vitreous luster, and forms long, thin crystals. It is also found in the metamorphic rocks of southeastern Pennsylvania.

PYROXENE GROUP: The most common pyroxenes in Pennsylvania are thought to be augite ($(\text{Ca}, \text{Na})(\text{Mg}, \text{Fe}, \text{Al}, \text{Ti})(\text{Si}, \text{Al})_2\text{O}_6$) and diopside ($\text{CaMgSi}_2\text{O}_6$). Both minerals are white to dark green or black. Vitreous luster. Short crystals or massive forms. Pyroxenes are important minerals in the mafic rocks of southeastern Pennsylvania, especially in the Jurassic diabase, where they make up half the rock.

TOURMALINE GROUP: Schorl ($\text{NaFe}_3\text{Al}_6(\text{BO}_3)_3\text{Si}_6\text{O}_{18}(\text{OH})_4$) is the most common species of tourmaline found in Pennsylvania. Black. Vitreous luster. Occurs as crystals found in metamorphic rocks of southeastern Pennsylvania. It is also found as tiny, radiating grains in many sandstones.

OLIVINE GROUP: Forsterite (Mg_2SiO_4) and fayalite ($\text{Fe}_2^{2+}\text{SiO}_4$) are the two most common species of olivine. Normally olive-green. Vitreous luster. Olivine in Pennsylvania commonly has a composition between those of forsterite and fayalite, but is closer to forsterite. It is found in southeastern Pennsylvania, where most of it has altered to serpentine. Small grains of olivine can be found in many serpentine deposits.

GARNET GROUP: Almandine ($\text{Fe}_3^{2+}\text{Al}_2(\text{SiO}_4)_3$) is one of several kinds of garnet found in Pennsylvania. Red color most common, but can be other colors. Vitreous to resinous luster. Garnets are found as crystals or irregular forms in the metamorphic rocks of southeastern Pennsylvania. Garnet sand can be panned from many streams in the glaciated regions of northwestern and northeastern Pennsylvania.

ZIRCON: ZrSiO_4 . Colorless or brown. Vitreous or adamantine luster. Occurs as crystals. Very small zircons are found in the igneous and metamorphic rocks of southeastern Pennsylvania and in many sedimentary rocks statewide. Because they are highly resistant to erosion, even the zircons found in sedimentary rocks commonly show their crystal form. Tiny zircons can be panned from streams throughout the state.

ECONOMIC IMPORTANCE/ GEOLOGIC IMPORTANCE

1. **APATITE**- Ground to make fertilizers Essentially the same chemical composition as teeth and bone.
2. **CALCITE**- Calcium carbonate. Chief mineral in limestone and shells of marine animals
Most common source of lime for use in chemicals and fertilizers
3. **CORUNDUM**: Used as an abrasive
Gem stone, when clear and red it is called a ruby. When blue called sapphire.
4. **FLUORITE**: Used as a flux in steel making also used to make glass and enamels.
5. **GYPSUM**: Used to make plaster. The variety alabaster is carved for ornaments.
6. **ORTHOCLASE FELDSPAR**: Important rock forming mineral. Weathers into clay.
Most common mineral. Used in ceramics and making porcelain.
7. **MILKY QUARTZ**: Used in making glass. Weathers into sand. Ore bearing (gold, silver, and heavy metals); rock forming mineral
3. **ROCK CRYSTAL QUARTZ**: Gemstone, prisms and electronics, jewelry; rock forming mineral.
3. **TALC**: Used in cosmetics, lubricants, a variety called soapstone is used for sinks and table tops.
10. **TOPAZ**: Gemstone, birthstone.
11. **AUGITE**: Important rock forming mineral
12. **GARNET**: Gemstone, birthstone, abrasive.
3. **HORNBLENDE**: Important rock forming mineral.
4. **KAOLIN**: Formed from feldspar, used in making china and tile.
5. **BIOTITE MICA**: Important rock forming mineral.
6. **MUSCOVITE MICA**: Insulator for electrical equipment. Iron stove windows. Named derived from Moscow, Russia where it was used as window glass.
7. **AMPHIBOLE ASBESTOS**: Used as heat and fire resistant material. Fibers woven into cloth.
8. **BAUXITE**: Aluminum ore.
9. **CASSITERITE**: Ore of tin.
0. **CHALCOPYRITE**: Most important ore of copper.
1. **GALENA**: Ore of lead.
2. **GRAPHITE**: Same composition as diamond (carbon) Used in pencils, lubricants, batteries.
3. **HALITE**: (Salt) Used in the manufacture of chemicals, flavoring, preservative.
4. **HEMATITE**: Iron ore, used as a polishing compound (Jewelers rouge). Used as a pigment.
5. **LIMONITE**: Iron ore.
3. **MAGNETITE**: Iron ore, natural magnet.

- 27. PYRITE: "Fool's Gold". Source of sulfur.
- 28. SPHALERITE: Ore of zinc.
- 29. SULFUR: Vulcanization of rubber, acids, medicine, matches, gun powder.

IGNEOUS:

- 30. BASALT: Most common rock in lava flows. Extrusive, Used in building foundations/ construction.
- 31. DIABASE: Intrusive rock, used in construction.
- 32. FELSITE: Extrusive rock
- 33. GABBRO: Intrusive rock, used in construction.
- 34. GRANITE: Intrusive rock. Most common rock in Earth's crust. Used in construction and tombstones.
- 35. OBSIDIAN: Volcanic glass. Used in jewelry, extrusive rock. Formerly used as arrowheads.
- 36. PUMICE: May float in water. Volcanic foam, used as an abrasive. Extrusive rock.

SEDIMENTARY

- 37. CONGLOMERATE: Freshwater or shoreline deposit. Mixture of sand, pebbles, and clay.
- 38. COMPACT LIMESTONE: Deep ocean deposit. Used in making cement.
- 39. COQUINA LIMESTONE: Shell fragments.
- 40. FOSSIL LIMESTONE: Organic sedimentary rock.
- 41. FLAGSTONE: Deep ocean deposit. Used in construction and as a building material.
- 42. SANDSTONE: Beach or wind deposit. Used in construction/ decorative stone.
- 43. SHALE: Deep ocean (deepest) deposit used in construction / decorative stone.
- 44. FOSSIL SHALE: Deep ocean deposit.

METAMORPHIC

- 45. BIOTITE GNEISS: Granite is parent rock.
- 46. MARBLE: Limestone is parent rock, used in construction and as a building material.
- 47. QUARTZITE: Sandstone is parent rock.
- 48. HORNBLENDE SCHIST: diabase or gabbro is parent rock.
- 49. MICA SCHIST: Mica is parent rock.
- 50. SLATE: Shale is parent rock. Used in construction, pool tables, roofing and blackboards.